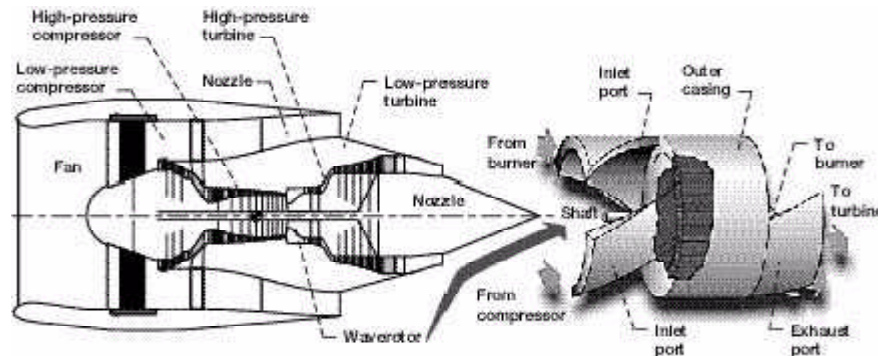
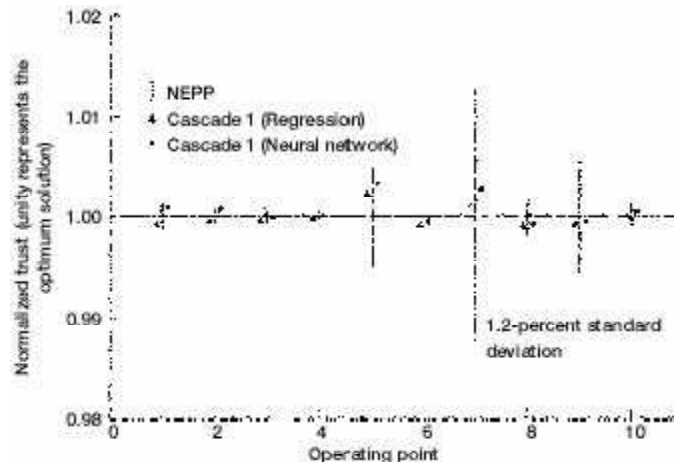


# Engine With Regression and Neural Network Approximators Designed



*Subsonic waverotor-topped gas turbine engine.*

At the NASA Glenn Research Center, the NASA engine performance program (NEPP, ref. 1) and the design optimization testbed COMETBOARDS (ref. 2) with regression and neural network analysis-approximators have been coupled to obtain a preliminary engine design methodology. The solution to a high-bypass-ratio subsonic waverotor-topped turbofan engine, which is shown in the preceding figure, was obtained by the simulation depicted in the following figure. This engine is made of 16 components mounted on two shafts with 21 flow stations. The engine is designed for a flight envelope with 47 operating points. The design optimization utilized both neural network and regression approximations, along with the cascade strategy (ref. 3). The cascade used three algorithms in sequence: the method of feasible directions, the sequence of unconstrained minimizations technique, and sequential quadratic programming. The normalized optimum thrusts obtained by the three methods are shown in the following figure: the cascade algorithm with regression approximation is represented by a triangle, a circle is shown for the neural network solution, and a solid line indicates original NEPP results. The solutions obtained from both approximate methods lie within one standard deviation of the benchmark solution for each operating point. The simulation improved the maximum thrust by 5 percent. The performance of the linear regression and neural network methods as alternate engine analyzers was found to be satisfactory for the analysis and operation optimization of air-breathing propulsion engines (ref. 4).



*Optimum solution for the waverotor-topped subsonic engine.*

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